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Dissertation on medical chemistry

Joseph Edgar Clark
Yale University.

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IV.

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By
Joseph Edgar Clark,
of Rootstown, Ohio,
Candidate for the Degree of Doctor in Medicine.

Medical Chemistry —

According to the Statutes of the state, it becomes necessary for candidates for degrees to present a dissertation, upon some subject, Connected with the Medical Seiences; and I am well aware that something of this Kind, will not only be expected, but absolutely required, and that excuses will avail nothing upon this occasion — I think however, it will not be expected, that the Student of Medicine who is an attendant upon a rapid Course of Lectures, in an Institution like this, which requires his strict and undivided attention to all the various branches that are continually urged upon his mind, and whose leisure moments for writing a dissertation are extremely few, and whose Knowledge of Medicine, is merely theoretical — Under these circumstances therefore, I trust it will not be expected, that any thing new or original will be

written, or that I shall render myself in the slightest degree interesting, to the Honorable Members of the Medical Board, before which it is to be delivered; more Especially, as the subject which I have selected, is one with which every Medical man, is already perfectly familiar — In pursuing Subject, I shall not confine myself strictly to what may be called Medical Chemistry, but deviate so far as to make a few general remarks relative to Chemistry as a Science, its rise and progress, and its application not only in Pharmacy, and Physiology, but also in the arts, briefly glancing at various Chemical topics as they may occur to my mind, and as I can collect them from the writings of various authors, making in short my Thesis some what of a miscellaneous Character —

Without further ceremony, I propose to proceed to my Subject, feeling an assurance that all errors and mistakes will be overlook-

Of all the various branches of the Physical Sciences, there is perhaps none more highly interesting to the Scientific man, and of more extensive application in the arts, or of more practical importance to the Medical Profession in particular than Chemistry — Although to one unacquainted with the Mysterious Laws by which it is governed, and the astonishing effects resulting from Chemical experiments &c, it would seem to be the least attractive, and most uninteresting, of all the Subjects connected with the Sciences; in as much as it occupies itself, in the investigation of the composition, properties, & Elementary Constitution of all Substances, and of the more obscure and apparently incomprehensible Phenomena, which are continually occuring in natural bodies many of which are unperceived by our Senses, or unaccompanied by Sensible motion

But on the contrary; The present advanced state of perfection, to which the Chemical Science has already attained; the present amount

of Chemical knowledge, and facilities for obtaining it, the dexterity with which the Chemical Philosopher of the present day, in his Labratory, manages to display or demonstrate Chemical facts, (of great importance to mankind), the brilliant and highly satisfactory results of his experaments, together with various other attractions all united can not fail to render it decidedly, the most interesting, and instructive branch of Natural Science —

Although it has been said that Chemistry as a science, could not be refered to a period, far beyond the commencement of the last century; yet we cannot for a moment doubt that the ancient Philosophers, attached great importance, to what was termed Chemistry or Alchemy, in as much, as it was the object of their researches, to discover what was by them called, the Philosophers Stone, and with which they immagined

they should be enabled to Convert the base metals into Gold, & Silver, or to discover the Grand Catholicon, or universal remedy; which was to remove every disease, to avert death, and confer terrestrial immortality upon man; also the universal Solvent which it was supposed nothing could resist, and these Miraculous virtues resided in one and the same Substance — Any farther than alchemy was concerned in the preperation or discovery of the Grand Catholicon or universal medicine which was fancied to be so admirably adapted for the removal of all diseases, and which was to prolong life to an indefinite length of time —

Any farther than this, it is generally believed, that Chemistry was not very extensively connected with Physic, until Comparatively a late period —

How far alchemy had extended among the ancients or whether it had

even assumed the form of a Sect, cannot be ascertained — Traces of it appear among the Greeks and Arabians — The Alchemists seem to have been established in the west of Europe, as early at least as the ninth Century — Between the Eleventh and fifteenth Centuries, it was in its most flourishing condition —

Gyber an Arabian Prince of the Seventh Century, is said to have been the Earliest Alchemist whose name has reached posterity — Also Rhases, & Avicenna, who were celebrated Physicians of the age, likewise Arabians, are said to be the first, who introduced Pharmaceutical preperations into their works; the latter of which, (Avicenna) describes particularly the method of Conducting distillation, He also mentions for the first time the Mineral acids, and speaks likewise of sublimed arsenic, and Corrosive Sublimate

In the Year 1226, Roger Bacon laid the foundation of Chemical Science in Europe — His discoveries were so Extraordinary

that he was excommunicated by the Pope, & imprisioned for ten years, for supposed dealings with the Devil — He was it appears a believer in a universal Elixer or he proposed one to Pope Clement the tenth —

Basil Valentine, a German, who is said to have been born in 1394, led the way to the internal administration of metalic medicine by a variety of experiments on the nature of Antimony —

It is believed that preperations of Iron were administered internally, as the Sulphate of Iron, it being mentioned as a tonic Styptic and astringent — He also mentions the volatile alkali, and its preperation from Sal-Ammoniac — and notices the production of Ether from Alcohol —

Paracelsus, who was born in the year 1493 - is said to have used Mercury internally, although its effects externally exterally were well known in the twelfth Century —

Paracelsus, thus armed with Opium &c
mercury and Antmony, remedies of no tri=
fling importance, travelled in all directions,
and performing many Extraordinary cu=
res, which brought him into notice, and
being well acquainted with Chemistry
Physic, was elected professor of Chemistry &
in 1527 which was the first Professorship,
that was Established in Europe, for the pro=
motion and dissemination of Chemical Scien=
While seated in his chair, he burnt with
great solemnity, the writings of Galen &
Avicenna, and declared to his audience,
that if God would not impart the Secr=
et of Physic, it was not only allowable,
but even justifiable, to consult the Devil
His Colemporary Physicians he treated
with the utmost contempt, and tells them
that the very down of his bald pate had
more knowledg, than all their writers,
the buckles of his shoes had more learning
than Galen & Avicenna, and his beard more

Experience than all their Universities —

With such a temper and disposition however, it could not be expected, that he should long retain his Chair — He quitted it in consequence of a quarrel with the Magistrates — and although he boasted of possessing a Panacea, which was capable of curing all diseases in an instant, and even of prolonging life to an indefinite length — Yet this drunkard, & prince of Empirics, died after a few hours illness, with a bottle of his immortal Catholicon in his pocket —

About a century of Paracelsus, Van Helmont, a man of Eminence took the lead in Physic, He may be considered as the last of the Alchemists, his death completed the disgrace of the universal Medicine.

He was the first Physician who applied alum in Uterine haemorrhage & acquired great reputation from the Success of the practice —

The foundation of the Alchemistical system, being thus shaken the facts ~~being~~ which had been collected soon became a heap of rubbish, and Chemistry was left without any fixed principles, and destitute of an object —

About this period, or in the year 1669 - Becher & Stahl, published at Frankfort a work entitled, Physic Subterranea - The publication of this book, forms a very important era, in the history of chemistry - It then escaped for ever from the trammels of Alchemy, and became the rudiments of the of science which we find it at present - It has been distinguished by the name of the Stahlian Theory —

Ever since the days of Stahl Chemistry has been cultivated with ardor in Germany, and the North, and the illustrious Philosophers of these countries have contributed highly towards its progress, and rapid improvement —

The most deservedly celebrated of these are Margraf, Bergman Scheele Klaproth &c— In France soon after the establishment of the Academy of Sciences in 1666- Homberg, Geoffroy, and Lemery, acquired great Celebrity by their chemical experiments and discoveries; and after the new modelling of the Academy-, Chemistry became the peculiar object of a part of that illustrious body- Rouelle, who was made professor of chemistry- in Paris about the year, 1745- Contrived to infuse his own enthusiasm into the whole body of the French literary men, and from that moment, Chemistry became the fashionable Study- Men of Eminence appeared every where; discoveries multiplied, the Spirit pervaded the whole nation, extended itself over Italy and appeared even in Spain—

After the death of Boyle, and of some other of the Earlier members of the Royal Society little attention was paid

to chemistry in Britain, except by a few individuals — The spirit which Newton had infused for the mathematical sciences, was so great, that for many years, they drew within their vortex, almost every man of eminence in Britain — But when Dr Cullen, became Professor of Chemistry in Edinburgh in 1756 — he kindled a flame of enthusiasm among the Students, which was soon spread far and wide by the subsequent discoveries of Black, Cavendish, and Priestly, and meeting with the kindred fires which were already burning in France, Germany Sweden, and Italy, the Science of Chemistry burst forth at once, with unexampled lustre — Hence the rapid progress which it has made during the last fifty, the universal attention which it has excited, and the unexpected light, which it has thrown upon several of the most important arts and manufactories —

During all this time Chemistry has sustained more or less intimate relation to the theory of medicine, the Pharmacopoeias and Dispensatories having kept pace with the scientific progress of the age.

In tracing the march of chemical improvement, we cannot but be struck with the new, and powerful remedies which it has introduced; and the many unimportant and feeble articles, which it has dismissed from medical practice — Opium has been at length compelled, to confess its secret source of action, and Ipecacuan to yield its emetic element in a state of perfect purity — Chemistry has also been the means of establishing the identity of many bodies which hitherto considered specifically different; thus an extensive list of animal substances have been discarded since it is known that they owe their properties to one and the same common principal viz gelatine, albumen,

carbonate of lime, &c so again the fixed alkaline salt, produced by the incineration of different vegetables, has been found to be potash from what ever plant it may have been obtained with the exception of Sea plants which yield Soda.

For the foregoing Sketch, or history, of the rise and progress of Chemistry thus far; I am indebted principally to the historical introduction, of Paris's Pharmacologia and the introductory remarks of Thomsons Chemistry, and others —

Some knowledge of Chemical arts, is said to be coeval with the earliest ages of antiquity — The application of Chemistry in the arts at the present time is very extensive, and it is more or less intimately connected with almost every branch of human industry — It is by the aid of Chemistry that, almost every Kind of manufacturers are Enabled successfully to go through with many of their most delicate processes, as bleaching, dye-

ing, and painting, also the manufactury of glass and the various kinds of pottery, and porcelain - It likewise furnishes mankind with a great variety of articles quite indispensable in domestic life, as sugar, vinegar, common salt, Sal Eratis, Soap, coloring materials &c - So also, in the more refined arts and acquirements as in daguerreotype drawing, plating by means of Galvanism, & the preperations of materials for painting - &

Again it has been found, by comparatively recent investigations and experiments, that chemistry bears an intimate relation, to agriculture, and this subject is now exciting the attention of the agriculturest, and is cultivated with great interest by men of science and learning, and anyone who has examined the works of Liebig and others, on the subject of agricultural Chemistry, will not hesitate to say with me that Chemistry contributes not a little, to the improvement, & advancement, of that branch

of human industry, most of all to be cherished among enlightened and civilized people—

Chemistry as a science—

Chemistry is defined by Dr Thomson to be "that" Science which treats of those Events or changes in natural bodies which are not accompanied by sensible motions"— "Chemical Events are equally numerous" says the same Author," and fully as important, as those, which belong to mechanical or Natural Philosophy for the Science comprehends under it almost all the changes in natural objects with which we are most immediately connected, and in which we have the greatest interest— Chemistry therefor is highly worthy of our attention, not merely for its own sake, because it increases our knowledge and gives us the noblest display of the wisdom and goodness of the Author of Nature— But it adds to our resources by Extending our dominions over the material world, and is therefor calculated to promote our enjoyment and ang-

ment our power — Again he remarks that Chemistry is intimately connected with a great variety of natural phenomena — All satisfactory explanation, of the causes of rain, snow, hail, dew, wind, Earthquakes, & Volcanoes, have been given by the aid of Chemical Knowledge — The phenomena of respiration, the decay and growth of plants, and some of the most important functions of the animal Economy, are also explained in a satisfactory manner, only by the aid of Chemistry — The laws which govern Chemical affinity, the doctrin of definite proportions, the Chemical effects of Electricity and Galvanism the expansive power of heat Evaporation the phenomena of flame and of Combustion, are among some of the most prominant which arrest the attention of the Chemical Student — The doctrin of definite proportions, or atomic numbers, is not only highly interesting as a subject of Philosophy but is also intimately connected with Chemistry, both as a Science, and a practical

art- Nothing perhaps, even the sublimest works of nature, are not more calculated to elicit the wonder and admiration of a reflecting mind, than this fact that substances combine with each other in exact and definite quantities, or proportions and that these proportions are the same in relation to the same substance throughout out the world, and have been so ever since the creation- This discovery may be considered as a new proof, directed expressly, to the present age, that the most minute works of what we call nature do indeed bear the most indubitable marks of divine agency and design- But while the discovery itself, is an evidence of the profane Philosophy of the present age, the development of its principals by the constant accession of new ideas, is calculated, rather to humble the pride of human knowledge by as constant conviction that after all our acquirements we know comparatively nothing of the laws and operations of nature

The very fact that the laws of proportions now, comparatively just known; to man, have existed

ever since the creation of matter, and have been in perpetual exercise all over the universe without a suspicion of their existence, is of itself a sufficient proof of the almost entire ignorance of man. Even of the phenomena of nature, and a still stronger proof of his ignorance of her laws"— "And if facts in themselves so simple, yet so wonderful, and when once known so obvious, have escaped the observation of men for thousands of years, is it not probable that phenomena are constantly going on before our eyes, which could we understand them, would astonish us still more - and at the same time, afford a still stronger conviction of our ignorance, and want of penetration?"

In the next place, I come briefly to consider the relation which chemistry bears to Physiology, and more particularly that branch which relates to the nutrition and growth of the animal system, and the production of animal heat &c. I am very well aware that this is a subject upon which there is a great difference of opinion, and that there are many who are unwilling to admit that Chemistry has any thing

what ever to do with Physiology, that it is a vital process only which suplies animal heat &c- In pursuing this subject, I shall copy clearly from Liebigs writings, - although there are some objections to his theory, yet it cannot be denied that he advances many very ingenious and satisfactory arguments in support of his doctrin —

In the preface to his work on organic Chemistry in its application to Physiology & Pathology the above named Author, says that "before the time of Lavoisier Scheele & Priestly Chemistry was not more closely related to Physics than she is now to Physiology. At the present day it is so fused as it were into Physics that it would be a difficult matter to draw the line between them distinctly — The connection between Chemistry and Physiology is the same and in a nother half Century it will be found impossible to separate them;" he furthermore remarks that "one of the most remarkable effects of the recent progress of science is the alliance of Chemistry with Physiology, by which a new and unexpected light

has been thrown upon the vital processes of plants and animals". "We have now no longer any difficulty in understanding the different actions of aliments, poisons and remedial agents, we have a clear conception of the causes of hunger, of the exact nature of death, and we are not as formerly obliged to content ourselves with a mere discription of these symptoms" "It is now ascertained with positive certainty that all the substances which constitute the food of man must be divided into two great Clases one of which serves for the nutrition and reproduction of the animal body, while the other ministers to quite different purposes"— "Thus Starch, Gum, Sugar, beer, wine, Spirits, &c furnishes no element capable of entering into the composition of the blood muscular fibre, or any part which is the seat of the vital principal — The primary conditions of the maintainance of animal life, are a constant supply of certain matters animal food, and of oxygen in the shape of atmospheric air —

During every moment of life, oxygen is absorbed from the atmosphere into the organs of respiration, & the act of breathing cannot cease while life continues — The observations of Physiologists have demonstrated that the body of an adult man, supplied abundantly with food, neither increases nor diminishes, in weight, during twenty four hours, and yet the quantity of oxygen absorbed into the system in that period, is very considerable —

According to the experiments of Lavoisier, an adult man takes into his system in one year not less than 746 pounds weight of oxygen, but we find his weigh at the end of the year either exactly the same, or differing one way or the other by at most a few pounds, No part of the oxygen remains in the body but is given out again in combination with Carbon and hydrogen — The Carbon and hydrogen of certain parts of the animal body, Combines with the oxygen introduced through the lungs and skin, and pass off in the form of carbonic acid and the vapor of water — We may assume with Lavoisier and Seguin that an adult man absorbs into his system

32 1/2 oz of oxygen daily, and father that the weight of the whole mass of blood, is 24 pounds, of which 80 per cent is water. Now from the known composition of the blood, we know that in order to convert its whole amount of carbon and hydrogen into carbonic acid and water, 64,102, grs. oxygen are required, this quantity, will be taken into the System in four days and 5 hours. It follows then that there must be a sufficient quantity of carbon & hydrogen taken into the system, in the form of food, to supply the oxygen. And unless this is the case, there will be a diminution in the weight, the oxygen combining with the tissues of the body containing those elements, which will be exhaled from the lungs and skin in the forms of Carbonic acid and water. Hence it is evident that the amount of nourishment required by an animal for its support must be in a direct ratio with the quantity of oxygen taken into the system. The consumption of oxygen in a given time, may be expressed by the number of respirations. It is therefore obvious that in the same animal the quantity of nourishment required must vary with the force and number of respirations.

A child breathes quicker than an adult, and consequently requires food more frequently, and proportionably in larger quantities, and hence hunger less easily - A bird, deprived of food dies on the third, while a serpent will live three months or longer without food - Air is expanded by heat, and contracted by cold. An Equal Column of hot and cold air contains therefore an unequal amount of oxygen - but Expire more carbon at a low, than at a high temperature, and require more or less carbon in our food in the same proportion, and consequently more is respired in the fridged, than in the torrid Zone - Even if an equal weight of food is consumed, in hot and cold climates, Infinite Wisdom has ordered that very unequal proportions of carbon shall be taken in it - as the food prepared by the inhabitants of Southern Climates, do not contain more than 12 per Cent of Carbon, while the blubber and train oil which feed the inhabitants of the polar regions contain from 66 to 80 per cent of that Element -

From what has been said we may conclude that the oxygen of the atmosphere, received into the blood in the Lungs, and circulating through out every part of the animal body, acting on the elements of the food, is the source of animal heat

All living creatures whose existance depends upon the absorption of oxygen, possess within themselves, a source of heat independant of surrounding objects —

In the animal body heat is produced only in those parts, into which arterial oxygenized blood, and with it the oxygen absorbed in respiration is conveyed — The Combination of a combustable substance with oxygen is under all circumstances the only source of animal heat —

In whatever way carbon may combine with oxygen, the act of combination is accompanied by the disengagement of heat —

It is indifferent whether this combination takes place rapidly, or slowly, at a high, or at a low, temperature, the amount of heat is

a constant quantity — The Carbon of the food being converted into carbonic acid within the body must give out exactly as much heat as if it had been directly burnt in oxygen gas, or common air, the only difference is the production of the heat, is diffused over unequal times — In oxygen gas the combustion of carbon is rapid and the heat is intense — in atmospheric air it burns slower and for a longer time in the animal body the combustion is still more gradual and the heat is lower in proportion — In the animal body the food & the fuel In the winter when we take exercise in a cold atmosphere, and when consequently the amount of inspired oxygen, increases; the necessity for food containing Carbon & hydrogen increases in the same ratio, and by gratifying the, when excited, we obtain the most efficient protection against the most piercing cold, a starving man is soon frozen to death — The animals of prey in the arctic region as every one knows far exceed in voracity those of the torrid Zone, Our clothing is nearly an equivalent

for a certain amount of food - If we were to go naked, like certain savage tribes, or if in hunting or fishing we were exposed to the same degree of cold as the samoyedes we should be able with ease to consume 10 pounds of flesh, and perhaps a dozen tallow candles into the bargain daily, as warmly clad travelers have related with astonishment of the people

According to the preceding exposition the quantity of food is regulated by the number of respirations by the temperature of the air, and by the amount of heat given off to the surrounding medium — The whole process of respiration appears most clearly developed when we consider the state of a man or other animals, totally deprived of food — The first effect of Starvation, is the disappearance of the fats, and this fat cannot be traced either in the urine or in the scanty feces — Its carbon & hydrogen has been given out through the skin and lungs, in the form of oxidized products, it is obvious that they have served to support respiration — In the progress of Starvation however it is not only the fat, which disappears, but also by degrees

all such of the solids, as are capable of being resolved as muscles and other of the organised tissues, and towards the end the particles of the Brain begin to undergo the process of oxydation, and delirium mania, and death closes the Scene— That is to say all the resistance to the oxidizing power of the atmospheric oxygen ceases, and the chemical process of Eremacausis or decay commences, in which every part of the body, the bones excepted, enters into combination with oxygen— The time which is required to cause death by Starvation, depends on the amount of fat in the body, on the degree of Exercise, as in labor, or exertion of any kind, on temperature of the air, and finally on the presence or absence of water— In all Chronic diseases death is produced in the same way viz: the chemical action of the atmosphere, overcoming the vital action or force"—

Again Liebig says that the substances of which the food of man is composed may be divided into two classes, into nitrogenized and non nitrogenized, the former are capable of

Conversion into blood, the latter are incapable of this transformation — Out of these substances which are adapted to the formation of blood are formed all the organic tissues — The other class of substances serve to support the process of respiration —

Among the former are reckoned vegetable fibrine Albumen, & caseine — Animal flesh & blood or animal fibrin, albumen, and caseine — Among the elements of respiration in our food, are fat, Starch, Gum, Sugar, Pectine, &c — The most recent and exact researches have established as a universal fact, to which nothing yet known is opposed that the nitrogenized constituents of vegetable food have a composition identical with that of the constituents of the blood — No nitrogenized compound, the composition of which differs from that from that of fibrine albumen and caseine is capable of supporting the vital process in animals — Chemical analysis has led to the remarkable result, that fibrine and albumen either vegetable or animal — and likewise caseine that nitrogenized constituent of milk, (the only one

upon which the growth of the organized tissues ~~of the~~ of the young animal depends, Contain the same organic elements united in the same proportions, that is that they are Isomeric, in their chemical composition, the proportion of their ultimate elements being identical, but the difference of their external properties shows that the particles of which they are composed are arranged in a different order — Both fibrine and albumen in the process of nutrition, are capable of being converted into muscular fiber, and muscular fiber is capable of being converted into blood — If now we compare the composition of organized parts with that of fibrin and albumen the following relations present themselves — All parts of the animal body which have a decided shape, which forms parts of organs, Contain Nitrogen — No part of any organ which possesses motion and life is destitute of nitrogen, all of them contain likewise Carbon & the elements of water — Finally water & Common fat are those ingredients of the body which are destitute of nitrogen — both are amorphous or unorganized, and only so far take part in the vital process, as that their presence

is required for the due performance of the vital functions — Much more might be written upon this subject, but time and space will not permit, neither does the occasion require it —

We come next to the subject of medical Chemistry; or that branch of the Chemical Science which aids in the preperation of many of our most efficatious and powerful medical remedies — If one were to draw a line of distinction between those medical substances which are formed by a purely Chemical process and those which are not; we should find that a large majority of our most potent remedies would be included under the Chemical division —

" Doct: A T Thomson. says that "the operations of Pharmacy which are strictly Chemical may be arranged in three classes —

First, Operations which produce changes seperating the constituents without any obvious decomposition —

Second, Operations in which changes are produced by the Chemical action of one set of bodies

upon a nother, or attended with obvious decomposition

Third, Operations in which the oxidizement and the deoxidizement of bodies are effected by means of a very high Temperature —

In the first Operations, the Changes are effected, 1st, By Calorie, inducing Liquefaction, Fusion, Evaporation, Distillation, Sublimation, &c and 2d, By water, and other fluids, as Solution, Maceration, Infusion Decoction &c

In the Second Operations, the Changes are by, Decomposition, Dissolution, Precipitation, Crystalization & Fermentation —

The Third, and last Class of operations in which oxidizement and deoxidizement are effected by means of a high temperature as fusion, Distillation, Sublimation, the oxidizement of metals, the Deoxidizement or reduction of metals

Thus we find the above classification Embracing an almost endless variety of medical bodies, as for example the Alkalies, Polafsa, Soda, and Ammonia — All the Metalic Oxides, as of Silver Mercury Copper Iron Lead Zinc

Antimony & Arsenic — So also all the acids as Sulphuric, Carbonic, Boracic, Acetic, Benzoic, and so on — And a long list of precipitates, as the metal Salts, and numerous others widely differing in there Sensable properties —

It was my intention to have dwelt longer upon this part of my Subject, but, want of time, and other circumstances will not permit — and furthermore I am well aware that quite enough has already been written unless better justice can be done the Subject,

Joseph E. Clark